Bat conservation in Australia

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Interest in bats in Australia is a rather recent phenomenon. Until the discovery around 1940 that bats were using ultrasound for navigation and food capture at night, bats had a mystical quality that generated fear and superstition. In a similar manner to most other western countries, Australians generally disliked or ignored bats. Despite this attitude no Australian bat species appears to have become extinct since the arrival of Europeans.

There is some evidence that there have been changes in the size and location of bat populations in the recent past. The extensive deposits in caves in the Flinders Ranges and in southwestern Western Australia are considered to be derived from guano produced by large numbers of bats which once inhabited these caves (Hamilton-Smith 1974). Dwyer (1965) has shown that erosional patterns, which are due to bat roosting behaviour, are found in several caves no longer inhabited by bats. These examples could date back to the Pleistocene and many merely reflect long-term climatic changes. Recent human activity, such as guano mining, could be the reason for bats abandoning caves which once contained large numbers, e.g., The Dip Cave, Wee Jasper and Johannsen's Cave, Mt Etna.

Ratcliffe (1931) reported that Grey-headed Flying Fox *(Pteropus poliocephalus)* numbers in south-east Queensland and New South Wales had diminished to "much less than half their previous strength". He considered that clearing of vegetation and harassment of camps during the breeding season were the causes of the decline. Studies by Nelson (1965) and personal observations have shown that the numbers of *P. poliocephalus* have continued to decline in south-east Queensland. The main reason for the decline appears to be the loss of habitat due to urbanization and clearing. In 1978 and 1979 there were mass spontaneous abortions of near full-term fetuses in several Grey-headed Flying Fox maternity camps in south-east Queensland. The cause was unknown but the effect was to almost halve the number of births for those two years.

Legislation protects all bats in Australia, except for the four species of flying fox *(Pteropus)* in Queensland. In 1985 the Queensland State Government bowed to electoral lobbying from fruit growers in the Granite Belt area and removed the four species of flying fox from the protected fauna list. This fruit growing area has a long history of problems with flying foxes but at that stage (pre 1985) fruit growers only had to telephone the local ranger to obtain a permit to kill raiding flying foxes. The removal of flying foxes from the protected fauna list in Queensland for political reasons without consultation with wildlife biologists can only be viewed as a retrograde step. It has serious management implications:

1. Now nobody has records of when, where, what species of flying fox, and what crops are being damaged.
2. With the lack of such records it is impossible that any sound management policy for flying foxes could or will be developed.
3. Flying foxes from other parts of Queensland, which never go near orchards, can be killed at any time. This includes pregnant females.
4. *Dobsonia moluccense* is virtually impossible to separate from species of *Pteropus* at night. This flying fox has a very restricted distribution in northern Queensland, and needs special protection.

The first attempt to assess the status of Australian bats was by Ride (1970) who listed species as rare when they were represented by only a small number in museum collections. Frith (1973) followed a similar protocol but added comments on the threats to the Australian bat fauna such as habitat clearing, specimen collection, roost destruction and environmental contaminants. Frith (1973) listed 12 species of Australian bats as being threatened but cautioned that further surveys and taxonomic studies could change the status of these bats.

Hamilton-Smith (1979) was the first person to specifically address the problem of bat conservation in Australia and discuss in detail the threats to bat survival. He listed the following factors as threatening the survival of Australian bats: deforestation, use of chemical insecticides with persistent residues, deliberate killing by humans for various purposes, destruction or closure of caves, and human disturbance of the cave environment. Those threats still remain. Of the two species Hamilton-Smith (1979) considered to have become extinct in recent times, *Myotis australis* is now known as a specimen aberration (Hall 1981) and *Nyctophilus howensis*, apart from being described from an incomplete skull in a subfossil deposit, will probably prove to be a junior synonym when the complex taxonomy of the genus *Nyctophilus* is finally unravelled.

As a result of taxonomic clarification and more effective bat surveys, the scenario of rare bat species painted by early authors (e.g., Ride 1970; Frith 1973) has changed. Following a World Wildlife Fund sponsored project on rare and endangered bats (Hall 1983) the status of several rare species improved. *Hipposideros stenotis*, which was only known from five specimens by Ride (1970), was found to be widespread in the Northern Territory, and *Nyctophilus walkeri*, known from only two specimens, was found to be plentiful in the Northern Territory and northwestern Queensland (Churchill *et al.* 1984). *Phoniscus papuensis*, which had been known from four specimens all collected prior to 1897, was caught during the survey (Hall 1983) and another three were caught by Lunney and Barker (1986). All the recent specimens of *P. papuensis*, were caught in bat traps (Tidemann and Woodside 1978) and this trapping method also resulted in the collection of a new bat species for Australia *(Murina florium)* (Richards *et al.* 1982). All specimens of *M. florium* were caught in cloudy upland rainforest in one locality in north-east Queensland. These examples emphasize the continual need for bat surveys using a variety of capturing and recording techniques. It is possible that there remains one or two undetected bat species in northern Australia.

Recently Richards and Tidemann (1988) discussed the effects of alteration and disturbance of habitat upon bat communities in Australia. They identified clearing and harvesting of temperate forests, selective logging in the wet tropics, and mining and agricultural practices as having major negative effects on the Australian bat fauna. These disturbances to habitat complement the major threats to bat survival outlined by Hamilton-Smith (1979).

Most human disturbances to the environment have obvious deleterious effects on bat roost sites, particularly deforestation and cave destruction. But what about foraging and feeding areas? Bats are opportunistic feeders and during the night often congregate at sites of food abundance. This can occur as a result of a local mass flowering of a particular tree species, as with blossom bats and flying foxes, or be a nuptual flight of termites where I have recorded up to five species of bats feeding together. Bats can feed over a wide range of habitats at night. Some only travel a few kilometres (Lunney *et al.* 1988), while others, such as flying foxes and bent-winged bats, will fly over 50 km from their daytime roost to feed.

Protection of feeding areas is much more difficult than roost or camp site protection. Our lack of knowledge of the causative agents for such phenomena as mass local flowering or nuptual insect flights makes it difficult to select suitable habitat for inclusion in a reserve. The irregular flowering of hardwoods and coastal paperbarks (e.g., *Melaleuca quinquenervia*) makes it almost impossible to prescribe discrete areas as a habitat for flying fox feeding. Obviously, large areas which form a mosaic and which are part of regional or continental habitat management, are needed. Then there is the long-term problem of the greenhouse effect! What do we do for the future?

Very few environmental impact studies ever consider bats. This is due in part to the lack of basic information in many areas of bat biology and some of the difficulties involved in surveying bats. Unfortunately bats receive little or no protection from contaminated areas, such as heavily sprayed crops or ponds of noxious chemicals which they mistake for water. Because of their manouevrability, bats can get access to ponds containing toxic substances which have been fenced off from less agile waterbirds. Dunsmore *et al.* (1974) found high levels of DDT in *Miniopterus schreibersii* in southeastern New South Wales where organochlorine insecticides are not used intensively. Juvenile bats had accumulated DDT in their tissue before they had left the maternity cave and Dunsmore *et al.* (1974) suggested that some bats could be carrying minimum lethal levels of DDT.

In south-east Queensland high levels of lead have caused mortality in flying foxes (Sutton and Wilson 1983; Sutton and Hariano 1986). The source of the lead is unknown, but the higher than average level of lead in petrol in Queensland (Anon. 1989) is indicative of this being the source. Currently, G. Hoye (pers. comm.) is monitoring fluoride levels around an aluminium smelter in the Hunter River Valley. Early analyses show that bats foraging close to the smelter have higher than normal levels of fluoride in their bones. The above examples show how the sensitivity of bats to environmental contaminants makes them valuable indicator species.

Bats spend half their life in a roost which has been selected with great precision with regard to its microclimate and morphology (Dwyer and Harris 1972; Hall *et al.* 1974; Hall 1982; Tidemann and Flavel 1987). Bat roosts are not always easy to find (particularly for tree-roosting species), and the changing physiological needs of bats during the year results in a variety of roosts being used by bats. Bats also change their roost site as a response to food shortage or abundance.

Because of the variety of roosts utilized by bats and their location there are endless problems in management and conservation of bats. Dead and live trees, under bark, in sheds and buildings (both old and new), abandoned mines and railway tunnels, caves (large complex limestone ones to small sandstone overhangs), under bridges, in vegetation, the list of bat roost sites is extensive. A large number of these roost sites in Australia

are on private land and face a multitude of problems for their care and survival. Cave and mine entrances become overgrown by weeds, caves are used as rubbish dumps or are developed for tourism, forests are cleared, old trees are removed for safety or firewood, sheds are pulled down and old mines collapse or get re-worked. A serious threat to a number of important colonies of cave-dwelling bats on Cape York is the gradual collapsing of the old mines in which they roost.

A number of important cave-dwelling bat maternity roosts have been protected by their inclusion in National Parks or Reserve. These include Naracoorte Cave, South Australia, The Drum Cave at Bungonia, New South Wales and Bat Cleft at Mt Etna, Queensland. Attention was drawn to these caves by the large numbers of bats using the cave. There are still many important maternity caves, however, which are on private lands and are unprotected. There are many maternity sites with small numbers of bats which are virtually unknown and certainly not catalogued by state fauna authorities. Several roost sites in Victoria, New South Wales and Queensland have been protected by fencing or gating the entrance to caves, mines and tunnels. This has been extremely effective with almost instant increases in the size of the bat colony. Restrictions imposed by the National Parks and Wildlife Service, New South Wales, and Conservation, Forests and Lands of Victoria on people entering caves which are used by bats as maternity sites or winter roosts have had a positive effect on bat numbers. Unfortunately there are still many important bat roosts not under the jurisdiction of state fauna authorities (e.g., Church Cave and Wee Jasper in New South Wales; Nowa Nowa in Victoria).

What Needs to be Done

Lunney (1989) listed priorities for bat conservation based on the analysis of a questionnaire answered by people attending the Eighth International Bat Research Conference in Sydney, July 1989. The survey constitutes a valuable statement for bat conservation in Australia because not only were over half of the respondents (37 of 70) Australian, but the analyses showed that the researchers from overseas shared the concerns and priorities so closely that all answers were pooled. The questionnaire addressed a large number of topics and there was broad agreement that the major issues in bat conservation were (in priority): effects of habitat fragmentation; effects of logging; bat surveys at specific location or habitats; and the effects of mining. Other priorities included: insisting on bat studies in environmental impact statements and education programmes; the need for studies of habitat and roost selection, and movements and diet; and the need to recognize the importance of seed dispersal by fruit bats. Lunney (1989) concluded from these results that there was the need for greatly increased attention to specific areas in bat conservation and that bat conservation should move into the public spotlight.

The following suggestions are for specific projects on bats and are not put forward as a *modus operandi* for bat conservation in Australia. This list is not in any particular order of merit. The projects reflect the author's personal feelings after 25 years of involvement with bats.

1. There is a need for a national register for bats in which information relevant to their management is kept. This register should be maintained by a federal authority and pay particular attention to rare, endangered and endemic species. Such a register should be the source of data on which the IUCN listings are based.

2. The register should emphasize critical sites for bats, such as maternity roosts, winter roosts and pre-maternity assembly sites.

3. Each state fauna authority should maintain a bat register and supply information to the national register.

4. A national co-ordinator is needed for bat study groups and the many interested people, both amateur and professional who have become interested in bats. This person needs to be apolitical and would need at least two days a week to prepare newsletters, literature reviews, and supply information to school children and people needing information on bats.

5. This co-ordinator could be funded from grants and could advise on research projects and other funding involving bats.

6. There is a need to conduct ecological studies on flying foxes. The sheer biomass of these animals, particularly in northern Australia, makes is plainly obvious that they have an enormous effect on flowering hardwoods. It appears that many species of plants, including commercial timbers, favour nocturnal pollinators.

7. The legislation in Queensland, which removed the four species of flying fox from the protected fauna list for that state, need to be immediately repealed. Bats should be included in all EIS studies and land management proposals.

8. A sensible and appropriate control programme needs to be developed for flying foxes in areas where orchards are raided.

9. A national census of the Ghost bat *Macroderma gigas* needs to be conducted to see if its IUCN rating is correct. Captive breeding and population genetic studies could be conducted on specimens occupying "artificial" roost sites, such as mines. Temperature regulation in this bat needs re-investigating with modern equipment and techniques.

10. More research needs to be done on *Rhinonicteris aurantius,* particularly in establishing this bat's maternity requirements, cave use patterns and factors limiting its distribution.

11. Monitoring the size of *Miniopterus* maternity colonies in eastern Australia at regular intervals is not difficult and would provide a useful indicator to the health of the bat community.

12. Regular monitoring of the levels of pesticides in bats, particularly using guano samples, is needed.

13. A tissue bank of bat specimens collected for various reasons could serve for long-term monitoring of environmental contaminants. This could be done by the national co-ordinator (4).

14. Further studies are required on forest bats, their roost sites, and their foraging behaviour. These data are needed before the full effects of habitat fragmentation and selective logging can be measured.

15. The practice of gating to protect bat roost sites in caves and mines should be encouraged.

REFERENCES

ANON, 1989. Australian-refined petrol has highest levels of lead. *Financial Review,* 22 May 1989, p. 48.

CHURCHILL, S. K., HALL, L. S. AND HELMAN, P. M., 1984. Observations on Long-eared bats *(Vespertilionidae: Nyctophilus)* from northern Australia. *Aust. Mammal.* **7:** 17-28.

DUNSMORE, J. D., HALL, L. S. AND KOTTEK, K. H., 1974. DDT in the Bent-winged Bat in Australia. *Search* **5:** 110-11.

DWYER, P. D., 1965. Bat erosion in Australian limestone caves. *Helictite* **3:** 85-90.

DWYER, P. D. AND HARRIS, J. A., 1972. Behavioural acclimatization to temperature by pregnant *Miniopterus* (Chiroptera). *Physiol. Zool.* **45:** 14-21.

FRITH, H. J., 1973. *Wildlife Conservation.* Angus & Robertson: Sydney.

HALL, L. S., 1981. The biogeography of Australian bats. Pp. 1555-83 in *Ecological Biogerography of Australia* ed by A. Keast. Junk: The Hague.

HALL, L. S., 1982. The effect of cave microclimate on winter roosting behaviour in the bat *Miniopterus schreibersii blepotis. Aust. J. Ecol.* **7:** 129-36.

HALL, L. S., 1983. A study of the status, habitat requirements, and conservation of rare and endangered Australian bats. Final report, Project 33, World Wildlife Fund (Aust): Sydney.

HALL, L. S., YOUNG, R. A. AND SPATE, A. P., 1974. Roost selection of the Eastern horseshoe bat *Rhinolophus megaphyllus.* Pp. 47-56 in *Proceedings of the 10th Biennial Conference of the Australian Speleological Federation: Sydney.*

HAMILTON-SMITH, E., 1974. The present knowledge of Australian chiroptera. *Aust. Mammal.* **1:** 95-108.

HAMILTON-SMITH, E., 1979. Endangered and threatened Chiroptera of Australia and the Pacific Region. Pp. 85-91 in *The Status of Endangered Australasian Wildlife* ed by M. J. Tyler. Royal Zoological Society of South Australia: Adelaide.

LUNNEY, D., 1989. Priorities for bat conservation. *Aust. Zool.* **25:** 71-78.

LUNNEY, D. AND BARKER, J., 1986. The occurrence of *Phoniscus papuensis* (Dobson) (Chiroptera: Vespertilionidae), in logged forest on the South Coast of New South Wales. *Aust. Mammal.* **9:** 57-58.

LUNNEY, D., BARKER, J., PRIDDEL, D. AND O'CONNELL, M., 1988. Roost selection by Gould's long-eared bat, *Nyctophilus gouldii* Tomes (Chiroptera: Vespertilionidae), in logged forest on the South Coast of New South Wales. *Aust. Wildl. Res.* **15:** 375-84.

NELSON, J. E., 1965. Movements of Australian flying foxes (Pteropodidae: Megachiroptera). *Aust. J. Zool.* **13:** 53-73.

RATCLIFFE, F. N., 1931. The flying fox *(Pteropus)* in Australia. *Bull. Council. Sci. Ind. Res. Aust.* **53:** 1-80.

RICHARDS, G. AND TIDEMANN, C., 1988. Habitat. The effects of alteration and disturbance upon bat communities in Australia. *Aust. Science Mag.* **2:** 40-45.

RICHARDS, G. C., HALL, L. S., HELMAN, P. M. AND CHURCHILL, S. K., 1982. The discovery of the rare Tube-nosed insectivorous bat *(Murina)* in Australia. *Aust. Mammal.* **5:** 149-51.

RIDE, W. D. L., 1970. *A Guide to the Native Mammals of Australia.* Oxford University Press: Melbourne.

SUTTON, R. H. AND HARIONO, B., 1986. Lead poisoning in flying foxes (Chiroptera: Pteropodidae). *Aust. Mammal.* **10:** 125-26.

SUTTON, R. H. AND WILSON, P. D., 1983. Lead poisoning in Grey-headed fruit bats *(Pteropus poliocephalus). J. Wildl. Dis.* **19:** 294-96.

TIDEMANN, C. R. AND FLAVEL, S. C., 1987. Factors affecting choice of diurnal roost site by tree-hole bats (Microchiroptera) in south-eastern Australia. *Aust. Wildl. Res.* **14:** 459-73.

TIDEMANN, C. R. AND WOODSIDE, D. P., 1978. A collapsible bat trap and a comparison of results obtained with the trap and with mistnests. *Aust. Wildl. Res.* **5:** 355-62.

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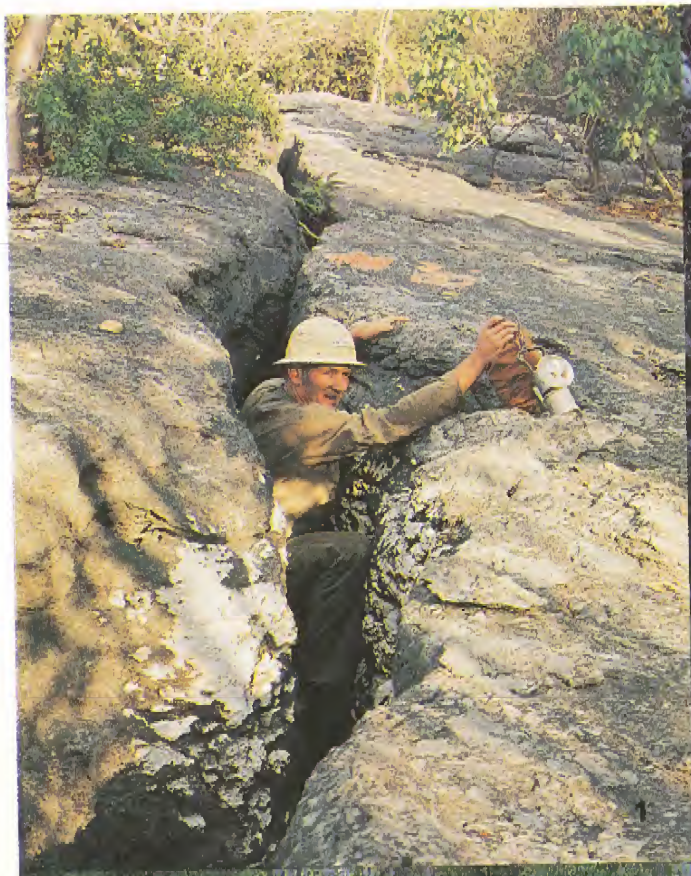

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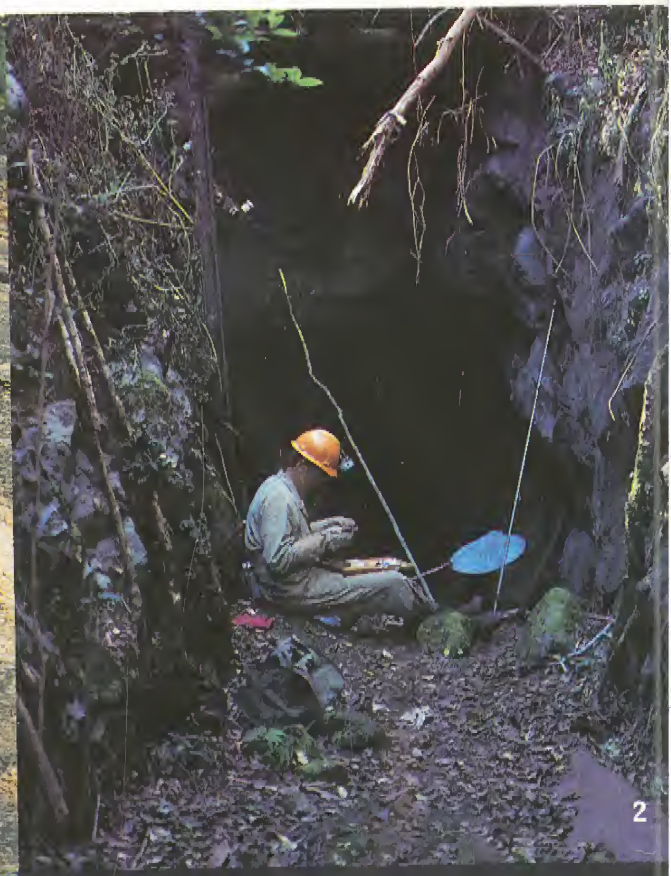

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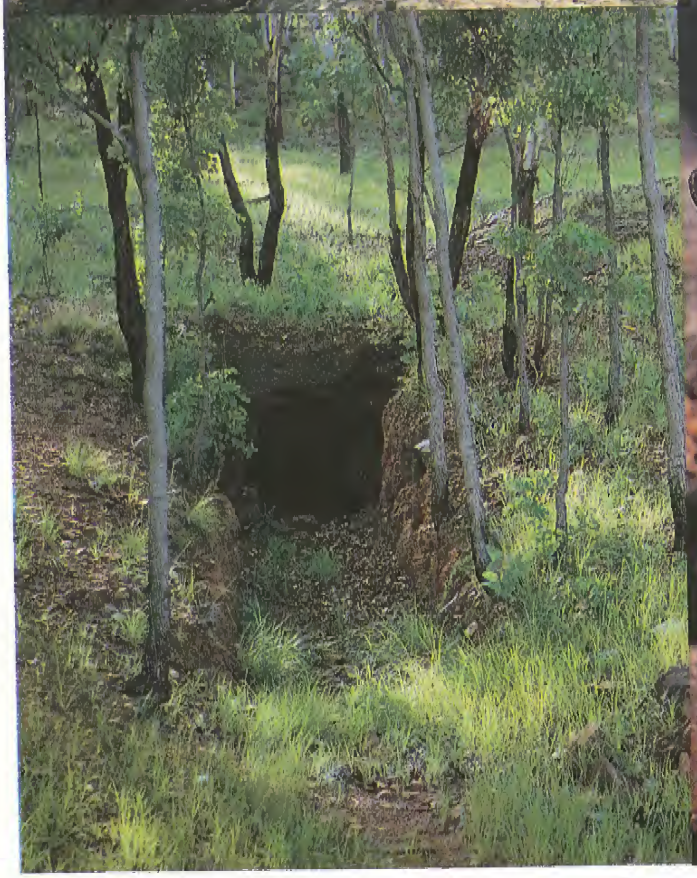

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Figure 1. Fanning River (Photo by Les Hall). This crack leads to a maternity cave for Little bent-winged bats (Miniopterus australis) *at Fanning River, Queensland. Its survival was threatened by limestone mining, but steps are now being taken to protect the site.*

Figure 2. Pinevale Mine (Photo by Les Hall). Abandoned mines have provided bats with suitable roost sites all over Australia. Unfortunately many of the mines are collapsing or being reworked. This old gold mine west of Mackay is home to four species of bats, but has commenced to cave in.

Figure 3. Conondale Mine (Photo by Queensland Forestry Department). This old gold mine in the Conondale Ranges, south-east Queensland has been gated and fenced to protect bats. Since the erection of the fence and gate by the Queensland Forestry Department, there has been a dramatic rise in the numbers of bats in the mine.

Figure 4. Pine Creek (Photo by Les Hall). Kohinoor mine, near Pine Creek in the Northern Territory contains the largest known colony of Ghost Bats (Macroderma gigas) *in Australia. Mining activities in the area could destroy the mine.*

Figures 5 and 6. Nyctophilus gouldii *(Photos by Les Hall). This long-eared bat is an important indicator species for forestry management. It lives in tree-hollows and under bark and never moves far from its roost site. More studies are needed to understand the effects of fragmentation and selective logging on this species.*